

The Integration of Enterprise Risk Management (ERM) and Environmental, Social and Governance (ESG) Factors

Mingyang Chang

University of Nottingham Ningbo China, Ningbo, China

Abstract

As the world deepens its understanding of sustainable development and corporate social responsibility, the ESG framework has become an important tool for assessing the comprehensive performance of companies. The effective integration of ESG factors into the risk management process and how this integration improves overall corporate performance are understudied. This study uses the ESG rating scores of Chinese listed companies and financial and market performance data of companies listed on the A-share market to empirically analyze the impact of corporate ESG performance on corporate risks. The study found that companies actively improving ESG performance can significantly improve their ability to withstand financial and market risks, and this conclusion still holds true after fully considering endogeneity issues such as variable measurement errors. Based on this research finding, this study recommends that the government vigorously promote the positive role of ESG information disclosure on enterprises and society, standardize and strengthen ESG information disclosure requirements, and recommend that companies substantively disclose ESG information, provide policy guarantees for corporate ESG practices, and simultaneously improve awareness of corporate sustainable development concepts.

Keywords

Enterprise Risk Management (ERM); ESG Performance; Empirical Analysis; Integration.

1. Introduction

The United Nations Environment Program (UNEP) proposed integrating the performance concepts of environment, society, and corporate governance into corporate decision-making, environment, society, and governance (ESG), which has attracted widespread attention from all walks of life. On the one hand, the government, society, and many scholars have begun to call and discuss that enterprises should not only focus on their economic interests but also pay attention to their sustainable development and take the initiative to assume more social responsibilities (Moon, 2007) [1]. However, as the scale of enterprise construction continues to expand, the problems of favoritism and fraud are increasingly intensifying. In addition, company operations and financial risks have gradually increased, resulting in frequent company bankruptcies. Affected by the modern enterprise system, fraud prevention, operational risk prevention, and financial risk prevention have become issues that must be solved to ensure the sustainable development of the company.

Risk is essentially uncertain. Enterprise risk refers to the impact of future uncertainty on an enterprise's ability to achieve business objectives (Lam, 2014) [2]. ESG factors affect corporate development from the perspective of risk and sustainable operations. The risk mitigation perspective based on stakeholder theory suggests that ESG can reduce corporate risk exposure (Aevoae et al., 2023) [3]. Higher ESG can reduce the possibility of negative events at the company level and prepare companies for possible difficulties in the future. Prepare during times of crisis (such as financial crises, economic recessions, and stricter regulations) to

mitigate the impact of risk events on enterprises. Under this framework, ESG is considered a good enterprise risk management tool; that is, companies with better ESG-related performance face smaller risks. Many studies have verified this theory. They generally believe that considering ESG factors in corporate strategies will help avoid negative events related to them (Sassen et al., 2016; Capelle-Blancard & Petit, 2019) [4][5].

Research on ESG has mostly focused on the relationship between ESG and corporate economic performance, and capital costs, lacking a comprehensive understanding of the consequences of assuming ESG responsibilities. As a manifestation of a company's comprehensive strength, will a company's ability to take risks be affected by ESG performance?

Rossi and Candio (2023) believe that using ESG scores as supplementary nonfinancial information can improve the accuracy of performance prediction and risk assessment [6]. Verheyden et al. (2016) show that considering ESG-related issues can reduce long-term corporate risks, increase risk-adjusted returns, and reduce capital costs [7]. Reber et al. (2022) also believe that considering ESG in corporate strategies can reduce a company's idiosyncratic risks in the long term [8]. Naseer et al. (2024) believe that ESG practices make companies less susceptible to reputational, political and regulatory risks, thereby reducing the volatility of cash flow and profitability [9]. Compared with peers in the same industry, the stock performance of companies that incorporate ESG factors is less volatile than that of their peer.

Some scholars believe that good ESG performance helps companies establish a positive image, improve corporate reputation, and enhance their ability to resist risks. Companies with good ESG performance have lower overall risks (Fu et al., 2024) [10]. Another group of scholars believes that the impact of corporate ESG performance on corporate risk is conditional. Negative ESG events cause the company's market value to decline and increase the company's investment risk (Sassen et al., 2024), but positive ESG events cannot significantly reduce the company's risk (Giese et al., 2019) [11][12]. ESG-negative events have a significant impact only on the corporate value and corporate risks of large companies because these companies have better performance and higher market attention (Capelle-Blancard & Petit, 2019) [13].

In general, there is a relative lack of research on the relationship between ESG performance and corporate risk, and the conclusions drawn are inconsistent. Further empirical research in this field is necessary to enrich and expand the research results. To clarify the impact of ESG responsibility on corporate risk, this study uses data from China's Shanghai and Shenzhen listed companies to study the relationship between corporate ESG performance and corporate risk.

2. Theoretical Analysis and Research Hypotheses

Based on the source and nature of risks, this study divides enterprise risks into market risks and financial risks and examines them from the perspective of investors and financial accounting.

2.1. The Impact of ESG Performance on Corporate Market Risks

Market risk is caused by changes in market interest rates, exchange rates, and stock and bond prices. Listed companies are affected by the market uncertainty in their operations. Based on the signaling theory, market risk is mainly caused by information asymmetry between enterprises and investors. If companies can improve this information asymmetry, they will gain investors' trust and help mitigate the negative impact of market risks on their stock returns (Xiang et al., 2012) [14]. Actively disclosing ESG-related information can help improve corporate information transparency, alleviate information unfairness between companies and investors, enable investors to comprehensively consider a company's financial and non-financial performance, and reduce investors' natural resource risks, thereby effectively reducing the volatility of stocks it issues (Hoang, 2018) [15]. LaBella et al. (2019) found that

companies with higher ESG ratings are more volatile than companies in the same industry [16]. This shows that companies that actively fulfill ESG responsibilities can better cope with the impact of market risks.

From an investment perspective, investors actively avoid companies with low ESG ratings, thereby effectively avoiding investment risks. Therefore, companies with good ESG performance can attract more investment and resources, and are more capable of facing market risks and stabilizing stock market prices. Companies that actively implement ESG concepts can not only win a good reputation for themselves and enhance the overall value, but can also win the long-term and stable trust and loyalty of investors (Hill, 2020) [17]. When the market falls, actively disclosing ESG information can help companies become more efficient in preventing market risk. Cardillo et al. (2023) found that investors believe that effective ESG risk management strategies make companies more flexible in responding to economic downturns and more prepared when risks come [18].

It can be seen that by actively disclosing ESG-related non-financial information, companies can improve their transparency, enhance investor trust and loyalty, obtain more market resources, effectively reduce the uncertainty of the company's future development, reduce market risks, and ultimately make The development of enterprises is more stable. Based on this, we propose hypothesis H1: Good ESG performance can reduce a company's market risk.

2.2. The Impact of ESG Performance on Corporate Financial Risks

The financial risk of an enterprise refers to the risk that the enterprise loses its ability to pay debts during its operating activities, causing its final financial results to deviate from the expected operating goals. It is possible that an enterprise's financial situation will lead to economic losses. As non-financial information, ESG performance can reflect a company's future operating risks and sustainable development capabilities. Siew et al. (2016) believe that the effective disclosure of ESG information can reduce information asymmetry between enterprises and stakeholders, improve stakeholder recognition, and accumulate corresponding social benefits [19]. There is a mutual causal relationship between corporate social responsibility performance and risk: good corporate social responsibility performance in the early stage can alleviate subsequent financial risks, and low financial risk in the early stage is conducive to subsequent corporate social responsibility fulfillment. Companies that do not actively fulfill their social responsibilities face higher financial risk (Zhao et al., 2016) [20].

Companies with better ESG performance are more likely to gain the favor of investors, reduce financing constraints and capital costs (Zhai et al., 2016), increase financial flexibility, improve their ability to respond to changes in the financial environment, and reduce corporate financial risk (Zhang & Liu, 2022) [21][22]. Empirical research on the Chinese stock market provides evidence that supports this argument. Chen et al. (2018) through research on non-financial insurance listed companies in China's Shanghai and Shenzhen A-share main board markets from 2010 to 2013, found that good social responsibility performance can enhance the company's operating capabilities, promote the performance of debt contracts, and reduce the risk of debt default [23]. Hu et al. (2023) analysis of defaulted securities and issued securities in various countries found that, fulfilling social responsibilities and corporate governance behaviors can reduce bond default rates (financial risks) [24]. Yan et al. (2022) and others also believe that actively assuming social responsibilities allows companies to gain the trust of stakeholders and the ability to develop sustainably, and improve the company's operating capabilities and solvency [25]. In particular, companies in areas with low marketization levels that actively assume social responsibility can effectively mitigate financial and default risks (Boubaker et al., 2020) [26].

Corporate investment in ESG performance may consume certain resources in the short term and increase the company's operating costs, which is not conducive to pursuing corporate

profit maximization goals. However, from the perspective of stakeholder-related theories, in the long term, companies actively improving ESG performance will not only help enhance mutual trust between them and stakeholders, but also help reduce the company's transaction costs and agency costs, improve operational efficiency, limit the short-term behavior of enterprises, and encourage enterprises to adhere to long-term value orientation in operations, thereby reducing the financial risks of enterprises. Based on this, we propose hypothesis H2: Good ESG performance can reduce corporate financial risks.

3. Research Design

3.1. Sample Selection and Data Sources

This article selects 2010-2020 as the research period and used companies listed on China's A-share market as the research sample. This study also eliminates some samples that do not meet the requirements based on the following principles: (1) eliminate listed companies in the financial and insurance industries; (2) eliminate ST samples; and (3) eliminate samples with missing values in key variables. After screening, 19,668 observed values were obtained for 3,175 listed companies. The ESG data used in this study were obtained from the Huazheng ESG ratings in the WIND database. Other data were obtained from the Guotai'an database (CSMAR). To eliminate the impact of outliers on the conclusions, this study winsorizes the continuous variables at the 1% and 99% levels.

3.2. Main Variable

(1) Interpreted variable: Enterprise risk. Enterprise risk refers to the possibility that future uncertainty will affect the profitability of an enterprise. This study measures this from two aspects: market risk and financial risk.

This study uses the standard deviation of corporate stock monthly returns to measure market risk, that is, the return volatility of stocks in the capital market is used to measure the risk level of companies. The greater the indicator, the higher the risk faced by the company. Additionally, this study uses Z-score to measure a company's financial risk. The Z value is inversely proportional to the company's risk, that is, the greater the Z value, the smaller the business risk. The Z-score was calculated using the Z-Score model constructed by Edward Altman (1968) to measure the financial status of enterprises [27]. Generally, the lower the Z value, the greater the financial risk of the enterprise; the higher the Z value, the smaller the financial risk of the enterprise, where the discrimination thresholds are 1.81 and 2.67 respectively (Farooq et al., 2022) [28]. If the enterprise's Z value is less than 1.81, the enterprise is considered to be in financial distress; if it is greater than 1.81 and less than 2.67, the enterprise's financial condition is unstable; if it is greater than 2.67, the enterprise's financial condition is healthy.

Stock return volatility reflects stock investors' expectations of a company's profit performance and risk-taking capabilities, while the Z-score uses corporate financial data to measure a company's debt and operating risks. This study utilizes these two methods to more comprehensively reflect the level of risks borne by enterprises.

(2) Explanatory variables: ESG performance. The rating results provided by the Huazheng ESG evaluation system were adopted for the ESG data. Huazheng's ESG evaluation system was divided into nine grades from C to AAA. To facilitate empirical analysis, this study assigned nine grades of C-AAA ratings from 1 to 9. The higher the score, the better the ESG performance.

(3) Control variables: To control for the impact of other factors on the research conclusions, referring to previous studies, this study selected enterprise size (Size), enterprise age (Age), asset-liability ratio (Lev), growth (Growth), return on total assets (ROA), return on equity (ROE), and other enterprise characteristic variables as control variables. Size takes the natural logarithm of total assets at the end of the year; Age = observation year - IPO year; Lev = total

liabilities/total assets; Growth = (total assets at the end of this period–total assets at the end of the previous period) / total assets at the end of the previous period; ROA = net fit/total assets; ROE = net fit/shareholders' equity balance. Because controlling for the impact of unclear factors at the macroeconomic environment and industry levels may have on corporate risks, this study uses dummy variables to control for year and industry.

3.3. Econometric Model

To test the impact of ESG performance on corporate risk, the specific regression model of this study is as follows:

$$\text{Risk}_{it} = \beta_0 + \beta_1 \text{ESG}_{it-1} + \beta_2 \text{ROE}_{it} + \beta_3 \text{Lev}_{it} + \beta_4 \text{Age}_{it} + \beta_5 \text{Size}_{it} + \beta_6 \text{ROA}_{it} + \beta_7 \text{Growth}_{it} + \sum \text{Year} + \sum \text{ind} + \varepsilon_{it}$$

Risk is corporate risk, which is the monthly return volatility of corporate stocks (Risk_Volm) and Z-value (Risk_ZScore). Among them, *i* represents the *i*-th enterprise; *t* represents the year in which the data are located, and ε_{it} represents other factors not considered in the model. Additionally, this study adds year (year) and industry (ind) dummy variables to control for the impact of year and industry factors. Considering that there is a lag in the value effect of ESG performance, and by one period to weaken the endogeneity problem caused by reverse causality, ESG is lagged by one period, represented by ESG_{it-1} .

4. Analysis of Empirical Results

4.1. Descriptive Statistical Analysis

The descriptive statistics of the primary variables are shown in Table 1.

Table 1. Descriptive statistical analysis

VarName	Mean	SD	Min	Max
Risk_Volm	0.122	0.055	0.043	0.339
Risk_ZScore	4.826	5.594	0.212	36.816
ESG	6.585	1.112	1.001	9.001
ROE	0.063	0.117	-0.579	0.311
Lev	0.436	0.201	0.063	0.866
Age	11.069	6.912	2.001	26.001
Size	22.377	1.285	20.101	26.361
ROA	0.039	0.058	-0.223	0.195
Growth	0.132	0.215	-0.271	1.123

Source(s): Authors work

The ESG data indicated that the highest value was 9.001, the minimum was 1.001, and the standard deviation was 1.112, and the mean value was 6.585. This indicates that Chinese organizations' overall ESG performance is above average; however, there is still a significant disparity in the challenges that various companies face in meeting their ESG obligations. Among the independent variables that measure corporate risk, the mean value of Risk_Volm is 0.122, the standard deviation is 0.055, the minimum value is 0.043, and the maximum value is 0.339, indicating that the market risks of different listed companies vary greatly. The mean value of Risk_ZScore is 4.826, the standard deviation is 5.594, the minimum value is 0.212, and the maximum value is 36.816. The lowest and maximum values are considerably diverse, demonstrating that the financial risks faced by different listed corporations vary greatly.

4.2. Correlation Analysis

Table 2 presents the results of the correlation analysis for the main variables.

Table 2. Correlation analysis

	<i>Risk_Volm</i>	<i>Risk_ZScore</i>	<i>ESG_{it-1}</i>	<i>ROE</i>	<i>Lev</i>	<i>Age</i>	<i>Size</i>	<i>ROA</i>	<i>Growth</i>
<i>Risk_Volm</i>	1								
<i>Risk_ZScore</i>	0.198 ^③	1							
<i>ESG_{it-1}</i>	-0.107 ^③	-0.055 ^③	1						
<i>ROE</i>	-0.049 ^③	0.165 ^③	0.127 ^③	1					
<i>Lev</i>	-0.046 ^③	-0.612 ^③	0.114 ^③	-0.131 ^③	1				
<i>Age</i>	-0.111 ^③	-0.159 ^③	0.207 ^③	-0.044 ^③	0.295 ^③	1			
<i>Size</i>	-0.181 ^③	-0.375 ^③	0.362 ^③	0.120 ^③	0.512 ^③	0.357 ^③	1		
<i>ROA</i>	-0.044 ^③	0.325 ^③	0.101 ^③	0.902 ^③	-0.331 ^③	-0.115 ^③	0.006	1	
<i>Growth</i>	0.094 ^③	0.012 ^①	0.003	0.321 ^③	0.028 ^③	-0.176 ^③	0.047 ^③	0.028 ^③	1

Source(s): Authors work. Note: ①②③ indicates significance at the 0. 10, 0. 05, and 0. 01 levels respectively.

It can be seen that without considering other influencing factors, the correlation coefficients between the explanatory variable *ESG_{it-1}* . and the explained variables *Risk_Volm* and *Risk_ZScore* are - 0.107 and - 0.055, respectively, and both were significant at the 0.01 There was a significant negative correlation between the levels. All control variables have a significant correlation with *Risk_Volm* and *Risk_ZScore*, indicating that the selection of the control variables is relatively reasonable.

In addition, the multicollinearity test (Table 3) shows that the mean value of the variance inflation factor VIF is 3.011, and the variance inflation factor VIF of all independent variables is less than the empirical critical value of 10.

Table 3. VIF test

<i>Variable</i>	<i>VIF</i>	<i>1/VIF</i>
<i>ROA</i>	7.331	0.135
<i>ROE</i>	6.690	0.148
<i>Lev</i>	1.821	0.547
<i>Size</i>	1.681	0.598
<i>Age</i>	1.121	0.832
<i>ESG_{it-1}</i>	1.181	0.844
<i>Growth</i>	1.181	0.848
<i>Mean VIF</i>	3.011	

Source(s): Authors work

Consequently, the model set in this investigation did not raise any major multicollinearity concerns.

4.3. Analysis of Regression Results

Table 4 presents the basic regression results for H1 and H2.

Column (1) shows that when *Risk_Volm* is used to represent market risk, the regression coefficient of *ESG_{it-1}* is significantly negative at the 1% level. In terms of economic significance, if a company's ESG rating increases by one notch, it reduces risk by 0.004, accounting for 1.82%

(standard deviation) of the sample company's risk volume mean (standard deviation). It can be seen that good ESG performance effectively alleviates the market risk of enterprises, thus supporting hypothesis H1.

Table 4. Model estimation

Variable	(1)	(2)
	Risk_Volm	Risk_ZScore
ESG_{it-1}	-0.004 ^③	0.128 ^③
	(-6.093)	(3.744)
ROE	0.028 ^③	-12.054 ^③
	(3.464)	(-16.551)
Lev	0.018 ^③	-13.862 ^③
	(6.606)	(-58.796)
Age	-0.000 ^③	0.010 ^①
	(-4.890)	(1.766)
Size	-0.009 ^③	-0.576 ^③
	(-20.128)	(-16.410)
ROA	-0.082 ^③	40.646 ^③
	(-4.766)	(26.124)
Growth	0.022 ^③	-0.386 ^②
	(11.071)	(-2.175)
Constant	0.286 ^③	21.258 ^③
	36.322	(29.340)
Year	Control	Control
Ind	Control	Control
Observations	16068	16068
R2	0.334	0.472
R2_a	0.332	0.470
F	242.006 ^③	434.746 ^③

Source(s): Authors work. Note: ①②③ indicates significance at the 0. 10, 0. 05, and 0. 01 levels respectively.

In the same way, the estimation results in column (2) show that when Risk_ZScore is used to represent financial risk, the regression coefficient of ESG_{it-1} is significantly positive at the 1% level, and the regression coefficient is 0.128, that is, for every increase in ESG level by 1 level, the enterprise The financial risk is reduced by 0.128 on average, and the reduction accounts for 2.63% (2.27%) of the mean (standard deviation) of the sample company's Risk_ZScore. It can be seen that good ESG performance can significantly reduce a company's financial risk, thus supporting hypothesis H2.

5. Robustness Test

To provide more robust research results and ensure the reliability of the research conclusions, this study conducted further robustness testing on the above regression process.

First, considering the measurement problem of variables, this study replaces the explained variables and uses the standard deviation of corporate stock daily returns Risk_Vold as the measurement variable for corporate risk to conduct a robustness test. The regression results are presented in Table 5.

Table 5. Robustness test 1 (replace the explained variable)

Variable	(1)	(2)
	<i>Risk_Vol_{it}</i>	<i>Risk_Vol_{it}</i>
<i>ESG_{it-1}</i>	-0.002 ^③	-0.0004 ^③
	(-24.104)	(-7.765)
<i>ROE</i>		0.004 ^③
		(2.766)
<i>Lev</i>		0.006 ^③
		(13.758)
<i>Age</i>		-0.000 ^①
		(-7.848)
<i>Size</i>		-0.004 ^③
		(-38.861)
<i>ROA</i>		-0.012 ^③
		(-6.604)
<i>Growth</i>		0.002 ^②
		(9.787)
<i>Constant</i>	0.034 ^③	0.064 ^③
	68.052	(68.943)
<i>Year</i>	<i>Control</i>	<i>Control</i>
<i>Ind</i>	<i>Control</i>	<i>Control</i>
<i>Observations</i>	16068	16068
<i>R2</i>	0.544	0.585
<i>R2_a</i>	0.543	0.585
<i>F</i>	722.128 ^③	716.715 ^③

Source(s): Authors work. Note: ①②③ indicates significance at the 0. 10, 0. 05, and 0. 01 levels respectively.

Table 6. Robustness test 2 (excluding special year samples)

Variable	(1)	(2)
	<i>Risk_Vol_{it}</i>	<i>Risk_Vol_{it}</i>
<i>ESG_{it-1}</i>	-0.002 ^③	-0.0004 ^③
	(-24.104)	(-7.765)
<i>ROE</i>		0.004 ^③
		(2.766)
<i>Lev</i>		0.006 ^③
		(13.758)
<i>Age</i>		-0.000 ^①
		(-7.848)
<i>Size</i>		-0.004 ^③
		(-38.861)
<i>ROA</i>		-0.012 ^③
		(-6.604)
<i>Growth</i>		0.002 ^②
		(9.787)
<i>Constant</i>	0.034 ^③	0.064 ^③
	68.052	(68.943)
<i>Year</i>	<i>Control</i>	<i>Control</i>
<i>Ind</i>	<i>Control</i>	<i>Control</i>
<i>Observations</i>	16068	16068
<i>R2</i>	0.544	0.585
<i>R2_a</i>	0.543	0.585
<i>F</i>	722.128 ^③	716.715 ^③

Source(s): Authors work. Note: ①②③ indicates significance at the 0. 10, 0. 05, and 0. 01 levels respectively.

It can be seen that there is still a significant negative impact on daily stock return volatility at the 1% significance level, which is consistent with previous results.

Second, a robustness test was conducted in the form of a sample replacement. As 2020 may be affected by the epidemic, the sample data for 2020 will be removed, and a robustness test will be conducted. The regression results are presented in Table 6.

After removing the sample data for 2020, the impact coefficient of Risk_Volm was - 0.002, and there is a significant negative impact at the 1% significance level, whereas there is a significant negative impact on Risk_ZScore at the 5% significance level. positive impact. Therefore, after excluding samples from special years, the empirical results were also stable and valid.

6. Conclusion and Suggestions

This study uses Huazheng's ESG rating scores of Chinese listed companies from 2010 to 2020, combined with financial and market performance data of listed companies on the A-share market, to study the impact of corporate ESG performance on corporate risks. The study found that companies actively improving ESG performance can significantly improve their ability to withstand financial and market risks, and this conclusion still holds true after fully considering endogeneity issues such as variable measurement errors.

Governments should vigorously publicize the positive role of ESG information disclosure in enterprises and society, standardize and strengthen ESG information disclosure requirements, advise companies on how to substantively disclose ESG information, and provide policy guarantees for corporate ESG practices while increasing corporate awareness of sustainable development concepts.

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